

CLAIMS

- 1 1. A method to pattern a workpiece with improved CD uniformity using a
2 partially coherent electromagnetic radiation source, including the
3 actions of:
- 4 - determining, for a plurality of layers in said workpiece, CD
5 uniformity as a function of a number of exposure flashes,
 - 6 - determining, for a plurality of layers in said workpiece, the
7 cost of patterning as a function of the number of exposure
8 flashes,
 - 9 - selecting the number of exposure flashes on a layer by layer
10 basis, which gives a predetermined CD uniformity
11 corresponding to a preferred cost.
- 1 2. The method according to claim 1, further comprising the action of:
- 2 - selecting a combination of values of the following
3 parameters:
 - 4 • radiation bandwidth
 - 5 • pulse length
 - 6 • radiation flash frequency
- 7 so that a calculated illumination non-uniformity (3 sigma) from
8 speckle amounts to less than 0.5%.
- 1 3. The method according to claim 1 or 2, further comprising the action of:
- 2 - determining a value of a slit width so that a calculated
3 illumination non-uniformity (3 sigma) from speckle amounts
4 to less than 0.5%.

1 4. A computer assisted apparatus for printing a workpiece with improved
2 CD uniformity by using a partially coherent radiation source,
3 comprising:

- 4 - logic and resources that determine, for a plurality of layers in
5 said workpiece, CD uniformity as a function of the number of
6 exposure flashes,
- 7 - logic and resources that determine, for the plurality of layers
8 in said workpiece, a cost of patterning as a function of the
9 number of exposure flashes,
- 10 - logic and resources that select the number of exposure flashes
11 on a layer by layer basis, which gives a predetermined CD
12 uniformity at a minimum of patterning cost.

1 5. A method for printing a workpiece with improved CD-uniformity,
2 including the action of:

- 3 - changing a number of exposure flashes per surface element
4 on a layer by layer basis.

1 6. A method for printing a workpiece with improved CD-uniformity,
2 including the action of:

- 3 - changing a pulse length of exposure flashes per surface
4 element on a layer by layer basis.

1 7. A method for printing a workpiece with improved CD-uniformity,
2 including the action of:

- 3 - changing a radiation bandwidth of exposure flashes per
4 surface element on a layer by layer basis.

1 8. A method for printing a workpiece with improved CD-uniformity,
2 including the action of:
3 - changing a slit width of exposure flashes per surface element
4 on a layer by layer basis.

1 9. The method according to any one of claims 5-8, wherein said changing
2 is performed for critical layers in the microelectronic device only.

1 10. A procedure to improve CD uniformity of a layer exposed in a scanner
2 or stepper using partially coherent light, including the actions of:

3 - providing a scanner system with an optical field larger than 10 mm,

4 - increasing one or more of the following parameters

5 a. slit width,

6 b. laser bandwidth,

7 c. pulse length,

8 d. laser flash frequency,

9 e. number of flashes,

10 f. number of flashes per field,

11 g. number of scan cycles per field

12 until the calculated illumination non-uniformity (3 sigma) from speckle
13 amounts to less than 0.5%.

1 11. The procedure as in claim 10 but with calculated speckle less than 1%.

1 12. The procedure as in claim 10 but with calculated speckle less than 2%.

1 13. The procedure as claimed in claim 10 but with calculated speckle less than
2 3%.

- 1 14. The procedure according to claim 10, wherein non-polarised light is used.
- 1 15. The procedure according to claim 10, wherein refractive optics is used.
- 1 16. The procedure according to claim 15, wherein at least one diffractive
2 element is used.
- 1 17. The procedure according to claim 15, wherein catadioptric optics with at
2 least one diffractive element is used.
- 1 18. A procedure to improve CD uniformity of a layer exposed in a maskless
2 scanner using partially coherent light comprising the steps of:
- 3 - providing a maskless scanner systems with an optical field larger than
4 0.5mm,
- 5 - increasing one or more of the following parameters:
- 6 a. laser bandwidth,
- 7 b. pulse length,
- 8 c. number of overlayed flashes,
- 9 until the calculated illumination non-uniformity (3 sigma) from speckle
10 amounts to less than 0.5%.
- 1 19. The procedure according to claim 18, wherein said calculated speckle is less
2 than 1%.
- 1 20. The procedure according to claim 18, wherein said calculated speckle is less
2 than 2%.
- 1 21. The procedure according to claim 18, wherein said calculated speckle is less
2 than 3%.
- 1 22. The procedure according to claim 18, wherein non polarized light is used.
- 1 23. An apparatus for printing a workpiece with improved CD uniformity
2 including:

- 3 - logic and resources to calculate the speckle,
- 4 - logic and resources that change the number of pulses per surface element on
- 5 a layer to layer basis.

1 24. A procedure for optimizing the speckle during microlithographic printing
2 including the actions of:

- 3 - providing a model for the value of improved CD uniformity,
- 4 - calculating the CD uniformity as a function of the number of flashes,
- 5 - providing a model for the cost of printing with a particular number of
- 6 pulses,
- 7 - providing logic and resources that select a number of flashes that
- 8 corresponds to a preferred result,
- 9 - providing a control adapted to change the number of flashes, and
- 10 - setting said approximately optimized number of flashes.

1 25. An electronic device with improved CD uniformity printed with speckle less
2 than 1% (3 sigma).

1 26. The method according to claim 23, further including the actions of:

- 2 - determining, for a plurality of layers in said workpiece, CD uniformity as a
- 3 function of a number of exposure flashes,
- 4 - determining, for the plurality of layers in said workpiece, the cost of
- 5 patterning as a function of the number of exposure flashes,
- 6 - selecting the number of exposure flashes on a layer by layer basis, which
- 7 gives a predetermined CD uniformity corresponding to a preferred cost.